Mating system

1. Monogamy

2. Polygamy
   - -Polygyny
   - -Polyandry

3. Promiscuity

Monogamy

One male and one female form a mating pair-bond during a given breeding season.

*Sexual monogamy: exclusive sexual partners

*Sequential monogamy: 1/1 sexual partner any given time period

*Social monogamy: social pair-bond

Why/ how evolve different mating systems?

1. Ultimate causes (Why)
   - what ecological factors shape the evolution of mating system?

2. Proximate causes (How)
   - genes, hormones, neural systems… influence the social behavior

Why evolve monogamy ? (Ultimate cause)

How can it possibly be advantageous for a male to inseminate only one female per season?

Sexual selection theory: a male's reproductive success : the number of females he inseminate.

The benefit of evolving monogamy in males must be greater than the benefit of polygamy.

Why evolve monogamy ?

How can it possibly be advantageous for a male to inseminate only one female per breeding season?

1. Mate assistance:

   Males remain with a single female to help rear their mutual offspring, otherwise the offspring might not be able to survive.

2. Mate guarding (for sperm competition):

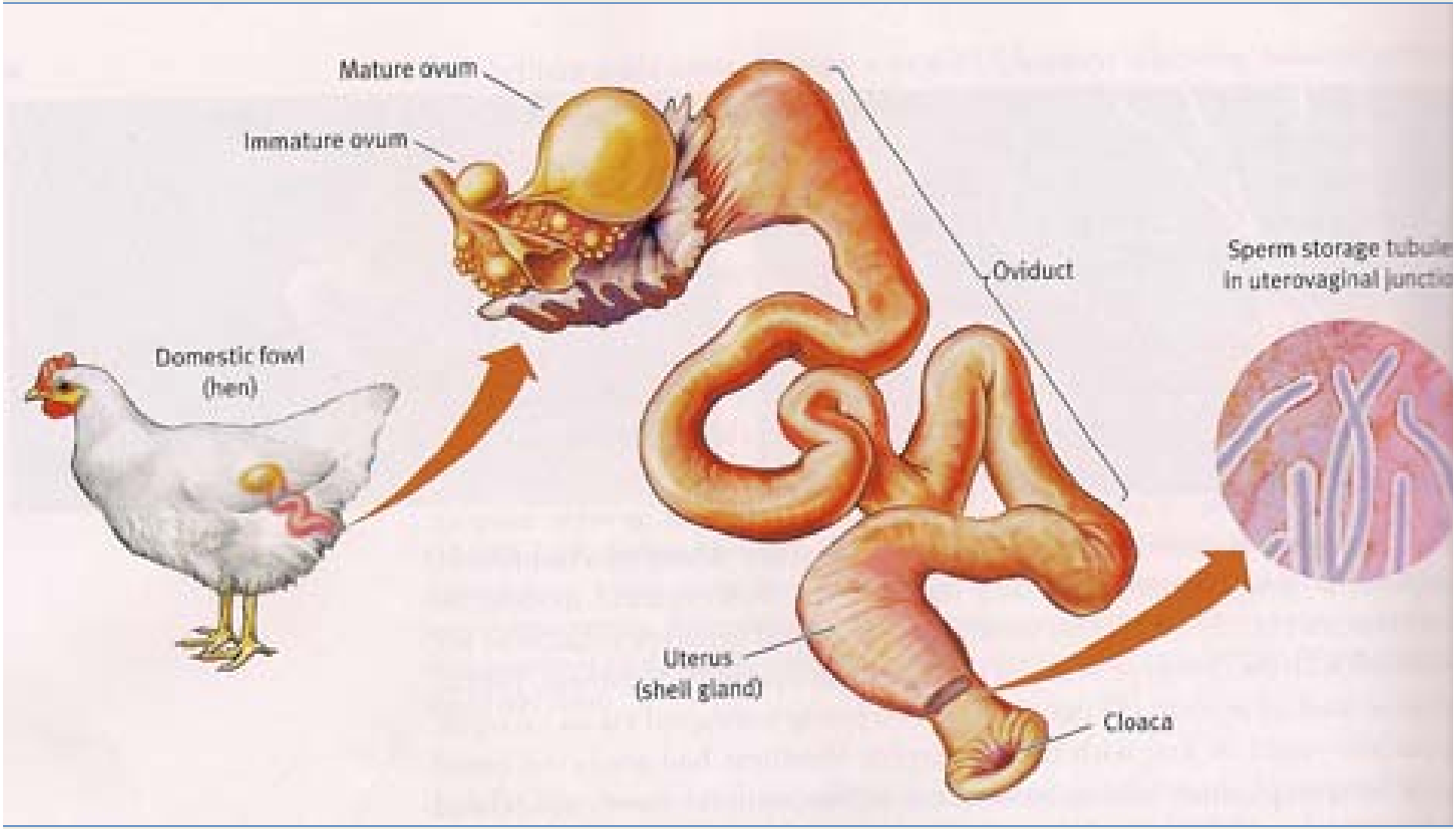
   A female left by one male would acquire another partner, whose sperm would then fertilize her eggs. Thus it is in the best interest of the first male to remain with his partner if receptive females or resources are scarce.

Sperm competition

Direct competition between the sperm of different males to fertilize a female's eggs –or mating success.

Females mate with many males, store sperms from numerous matings, sperms from different males may compete with one another over access to fertilizable eggs.

Females encourage sperm competition

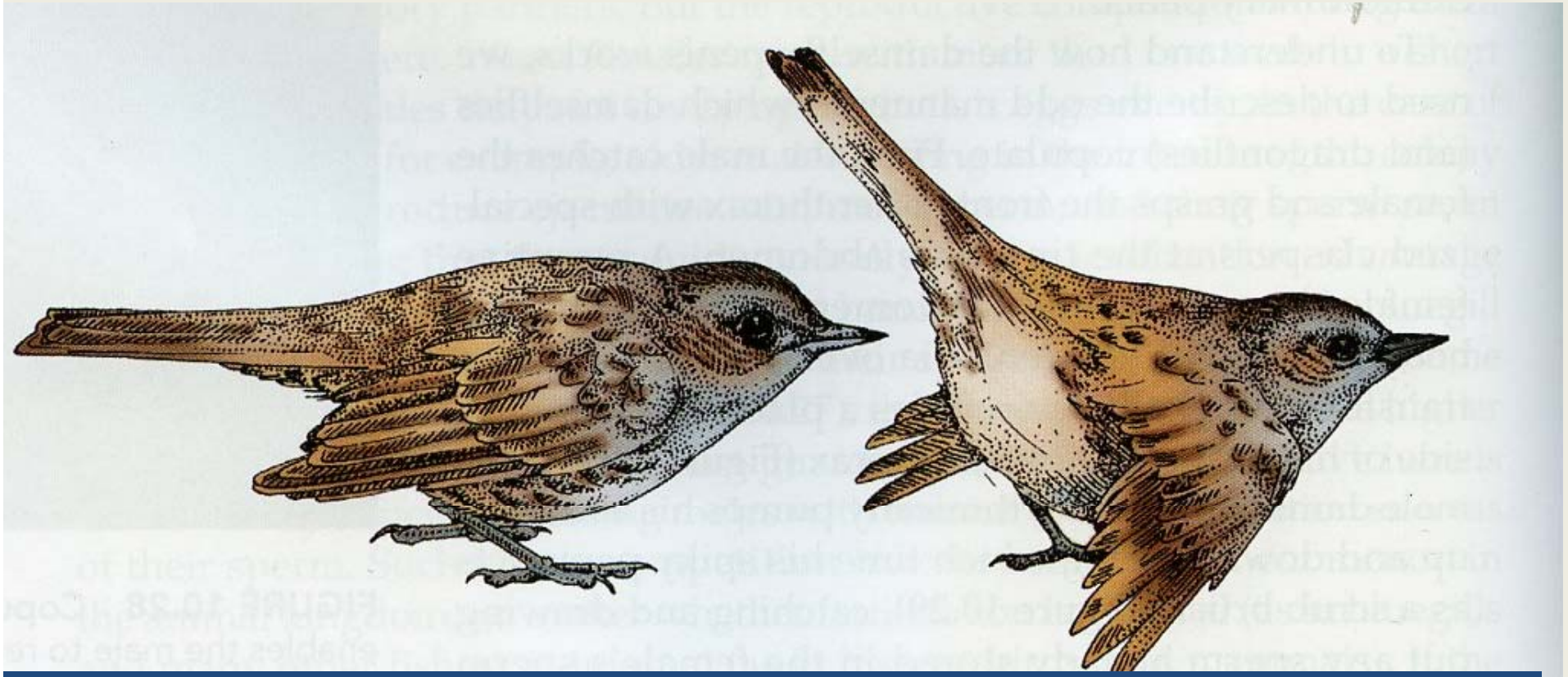


What kind of males can win sperm competition?

Dunnocks and sperm competition

Male dunnocks compete for mating access to the female, but DNA evidence has shown that chicks within broods often have different fathers, depending on their success at monopolizing access to the fertile female (sperm competition)

Dunnocks and sperm competition



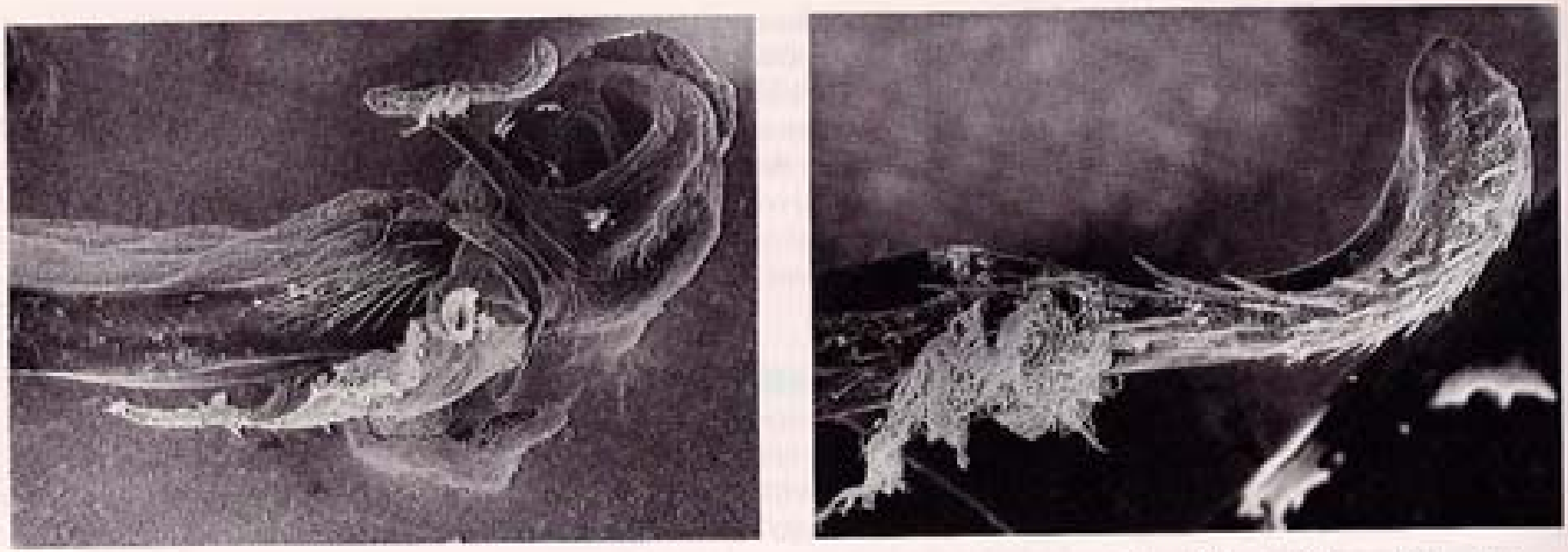
Males try to ensure their paternity during courtship by pecking at the cloaca of the female to stimulate her to eject the sperm of other males with whom the female has recently mated. Dunnocks take just one-tenth of a second to copulate, and have sex more than 100 times a day.

Sperm competition

Black-winged damselfly

Sperm competition

Black-winged damselfly
Female: sperm storage organ
Male: specialized penis



23 Sperm competition in the black-winged damselfly. (Left) The male's penis has lateral horns and spines that enable him to scrub out a female's sperm storage organ before passing his own sperm to her. (Right) A close-up of a lateral horn reveals rival sperm caught in its spiny hairs. Photomicrographs by Jon Waage, from Waage [1177].

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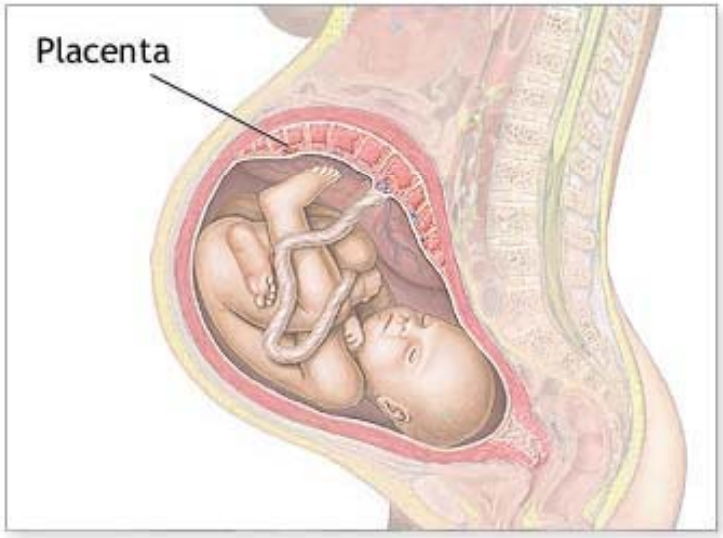
Birds: more than 90% bird species are socially monogamous.

Mammals: less than 5% mammalian species are monogamous.

Why monogamy is rare in mammals?

-- placenta, mammalian pregnancy;
milk production in females.

-- males are free from these constraints.
free from parental care



Why most birds are monogamous?

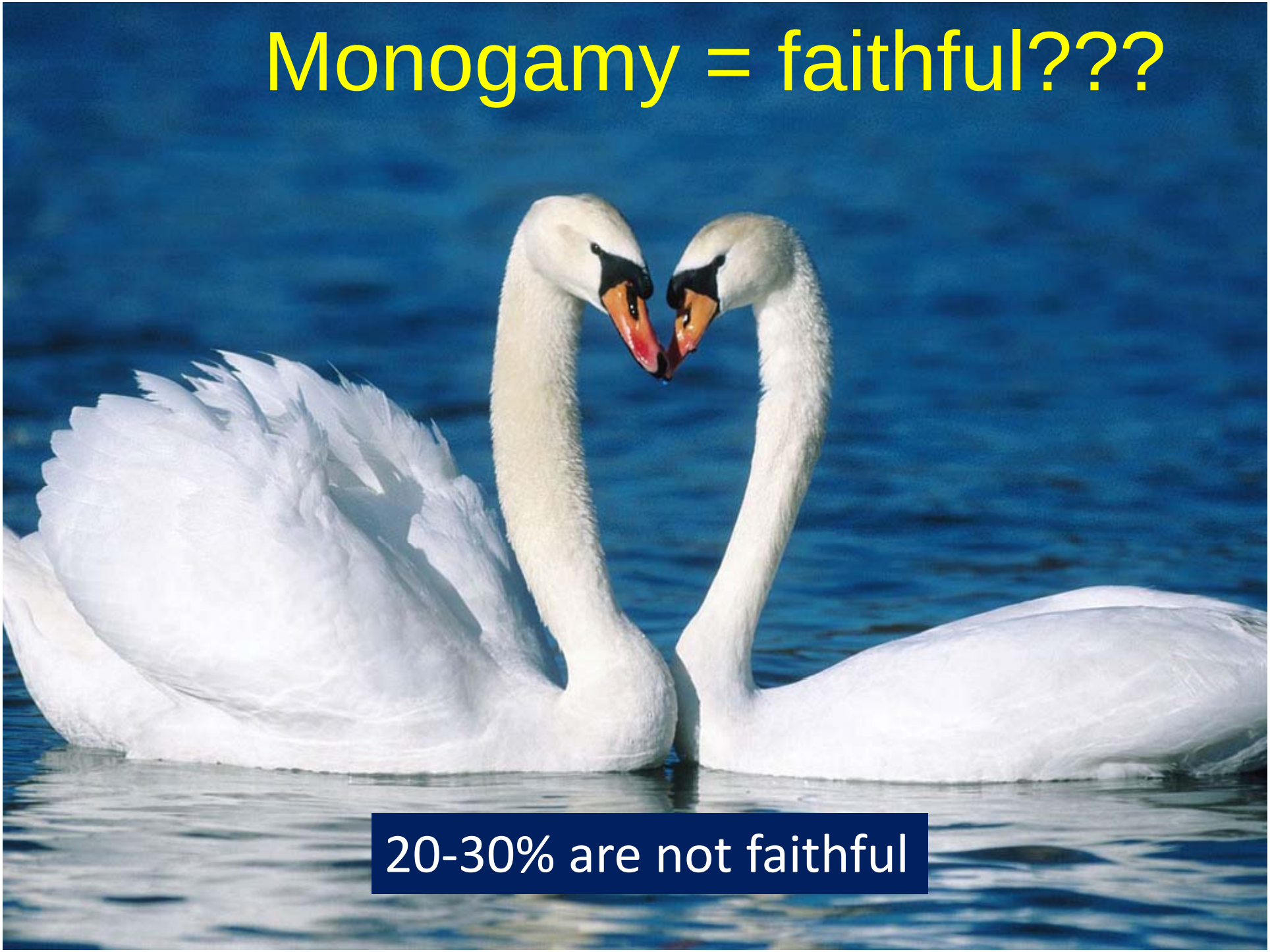
-- Eggs are laid/incubated outside female body. males might need to share the parental duty

-- Parental care (incubation, feeding young…) demand more paternal effort.

-- Males: chose leave or not leave?




Monogamy = faithful???



20-30% are not faithful

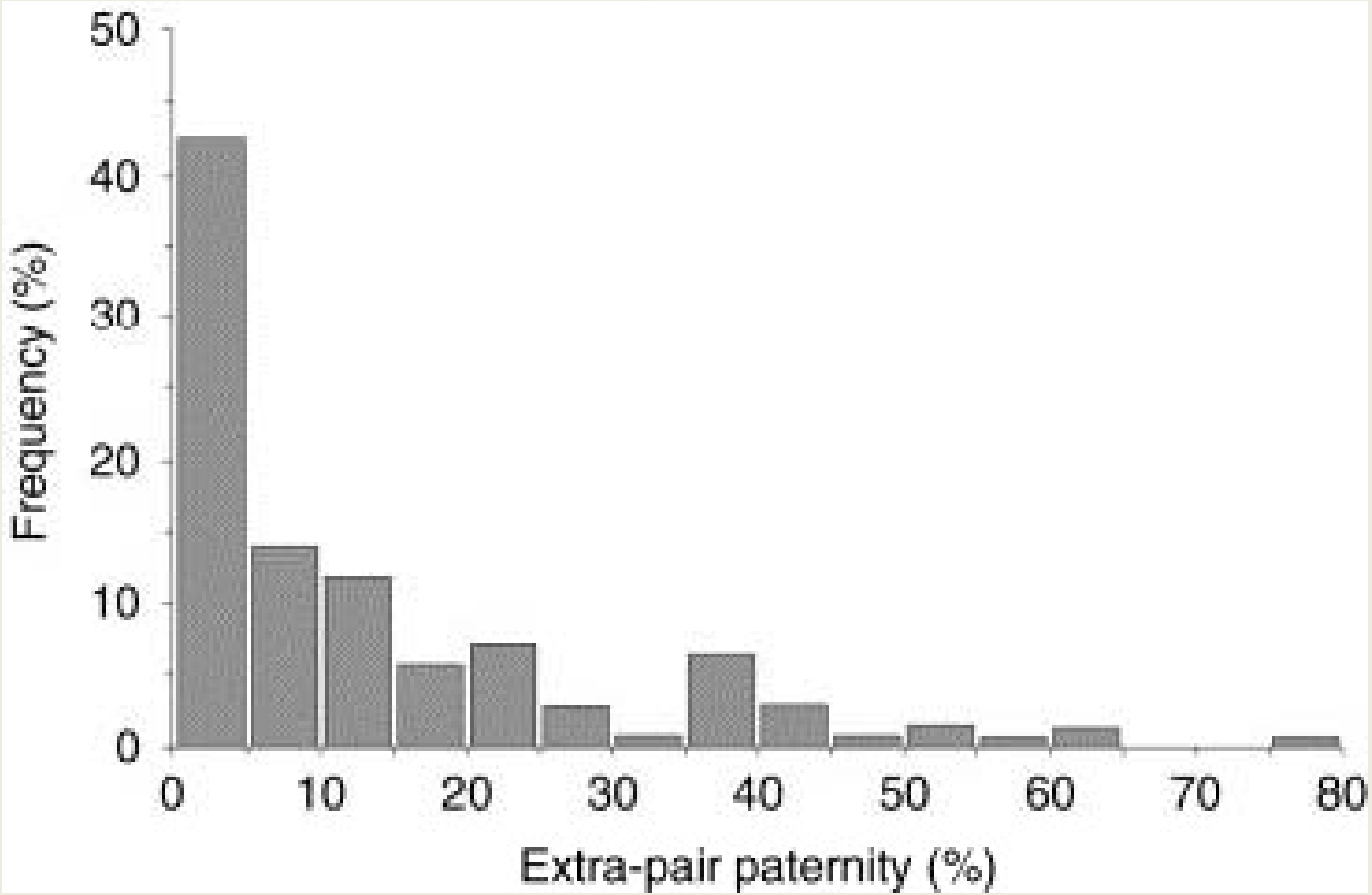
Although most birds are monogamous.. most are socially monogamous (not exclusive sexual partners)

-- most birds regularly mate with others, outside of the pair bond: extra-pair copulation

-- identified by extra-pair paternity using DNA microsatellite analysis

-- Why do females engage in extra-pair copulation?

Extra-pair paternity are common across socially monogamous bird species



Why monogamous females have extra-pair copulation?

1. Good gene hypothesis:
   her social mate might not have the best gene.
   --for example: sperm competition.

2. Fertility insurance :
   reduce the risk of having an infertile male partner.

3. Genetic compatibility hypothesis:
   increase genetic variety of the sperms

4. Material benefit:
   better protection, access to resources

Few monogamous species are faithful to their partners

Common Loons: ~100% paternity to their social mate

Polygyny

A male fertilizes the eggs of several females during a given breeding season.

Polygyny

Three categories:

- 1. Female defense polygyny
  (males defend female-herd: red deer)
- 2. Lek polygyny
  (males defend display arena: bowerbird)
- 3. Resource defense polygyny
  (males defend territory, food…)

1. Female-defense polygyny: red deers males defend females (harem) and move with them, no specific territory

2. Lek polygyny:

Lek: males defend small display arenas
(not a territory for breeding)
--lek is used only for display and mating;
--lek provides no food or nest site.

3. Resource-defense polygyny

--Male defend territory: the territory provides food or good nest site, females choose territory with good resource

For resource-defense polygyny to evolve:

1. Uneven distribution of resources (food, shelter…)

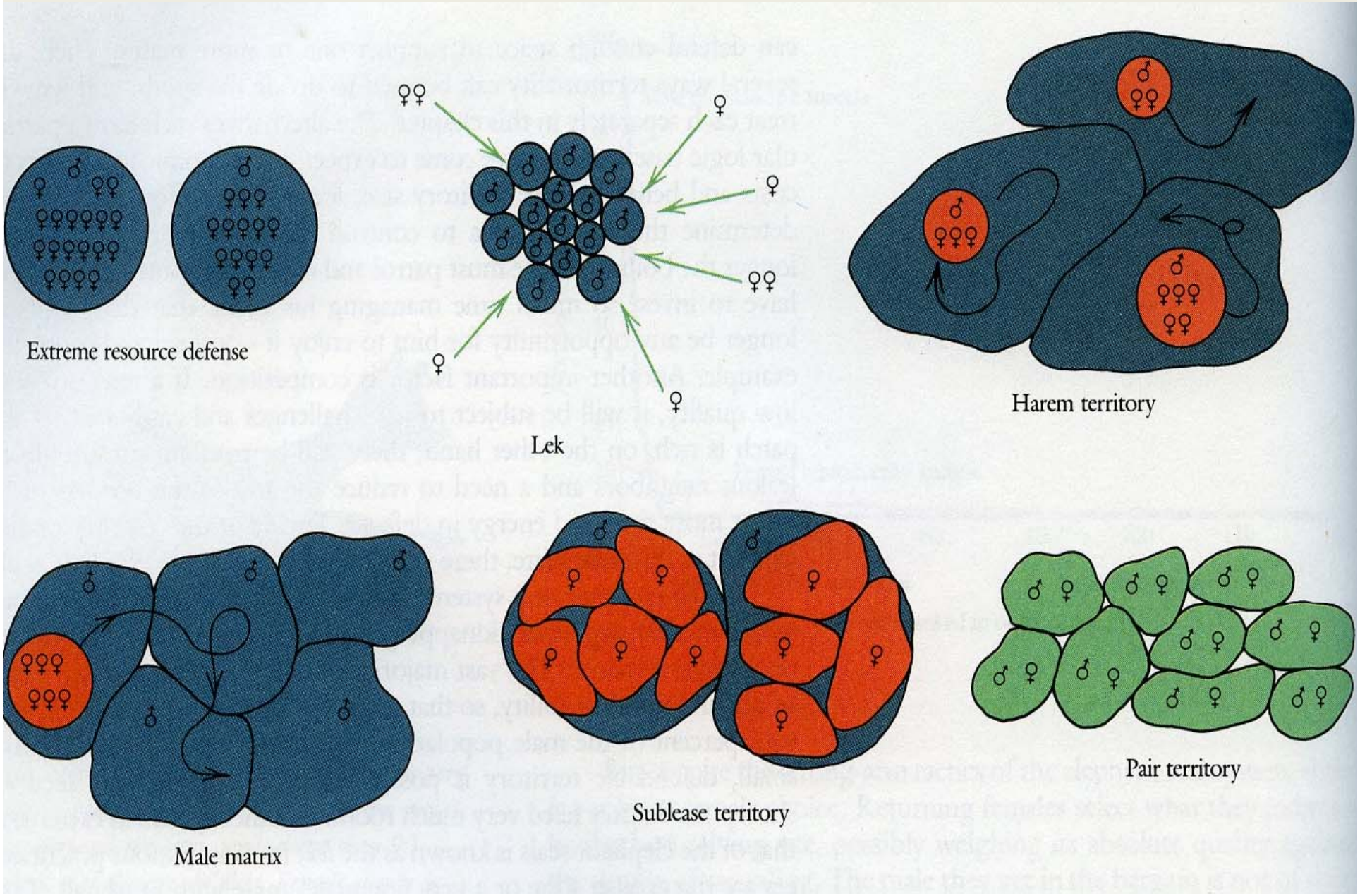
2. Females choose the rich resources, the benefit is greater than the cost of without male-assisted parental care

3. Resource-defense polygyny

--Females have to choose:

should a female choose a bachelor (can provide parental care) or choose a paired male with abundant resources?

3. Resource-defense polygyny



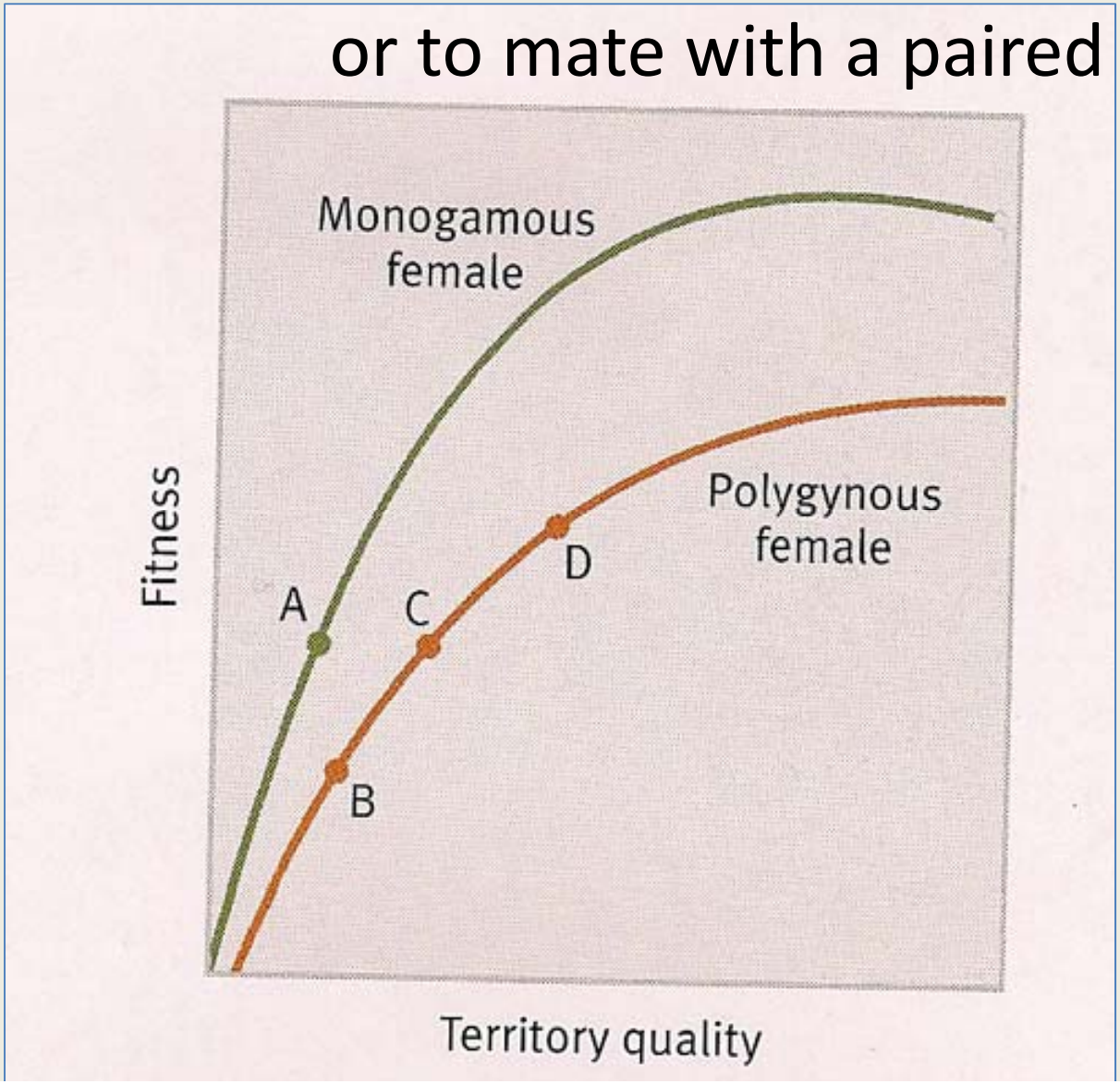
Polygyny threshold model

When the quantity or quality of resources controlled by males varies greatly, females that join already paired males on very rich or very safe territories may have more surviving offspring than if they were to pair off single males on resource-poor territory.

Polygyny threshold model

females choose: to mate with an unpaired male

or to mate with a paired male



Polyandry

A female pair-bonds with more than one male during a given breeding season.

<u>Rare in animals</u>

Wattled Jacana

Females are larger; defend territories

Males take care of young.

Humans: polyandry is rare

Tibet

Promiscuity

Both males and females mate with many partners, no committed relationships.

Bonobo (pygmy chimpanzee)

Bonobos:

Matriarchal- females as the dominant member of a group.

Most peaceful apes

Use sex (both homosexual and heterosexual) for:

1. Reproduction
2. Social status (social ranking)
3. Social greeting
4. Pre-conflict resolution
5. Post-conflict resolution
6. Group foraging; group contact

Bonobos:

Matriarchal

why females have sex with other females

Researchers found that low-ranking females made distinctive sounds — called "copulation calls" — during sex with high-ranking females in order to brag to other top females around them. Using vocalizations, females only advertise sexual contacts with important group members.

Proximate causes of mating systems

Vasopressin and pair-bonding

Prairie vole
-monogamous, strong
social pair-bond

Meadow, Montane vole
- solitary, polygamous
(close relatives of prairie vole)

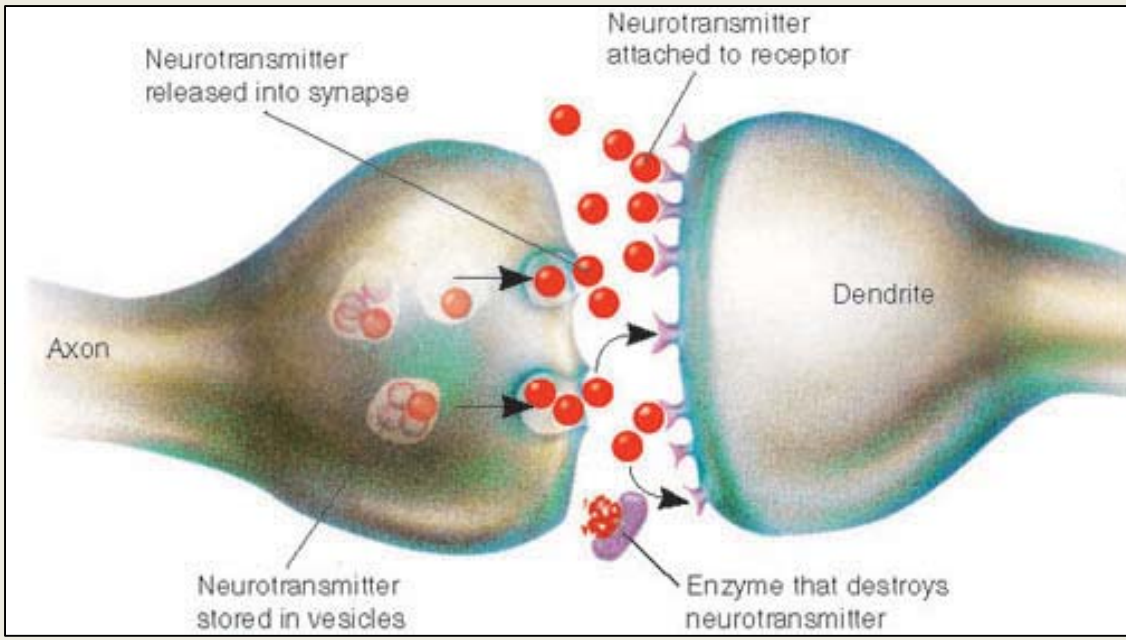
1. Prairie voles: higher distribution of **<u>V1aR</u> (Receptor),**
higher V1aR expression in the ventral forebrain.

2. Both species have **V1aR gene**, vasopressin,
same neural pathway for pair-bonding behavior.

Vasopressin

(brain hormone)

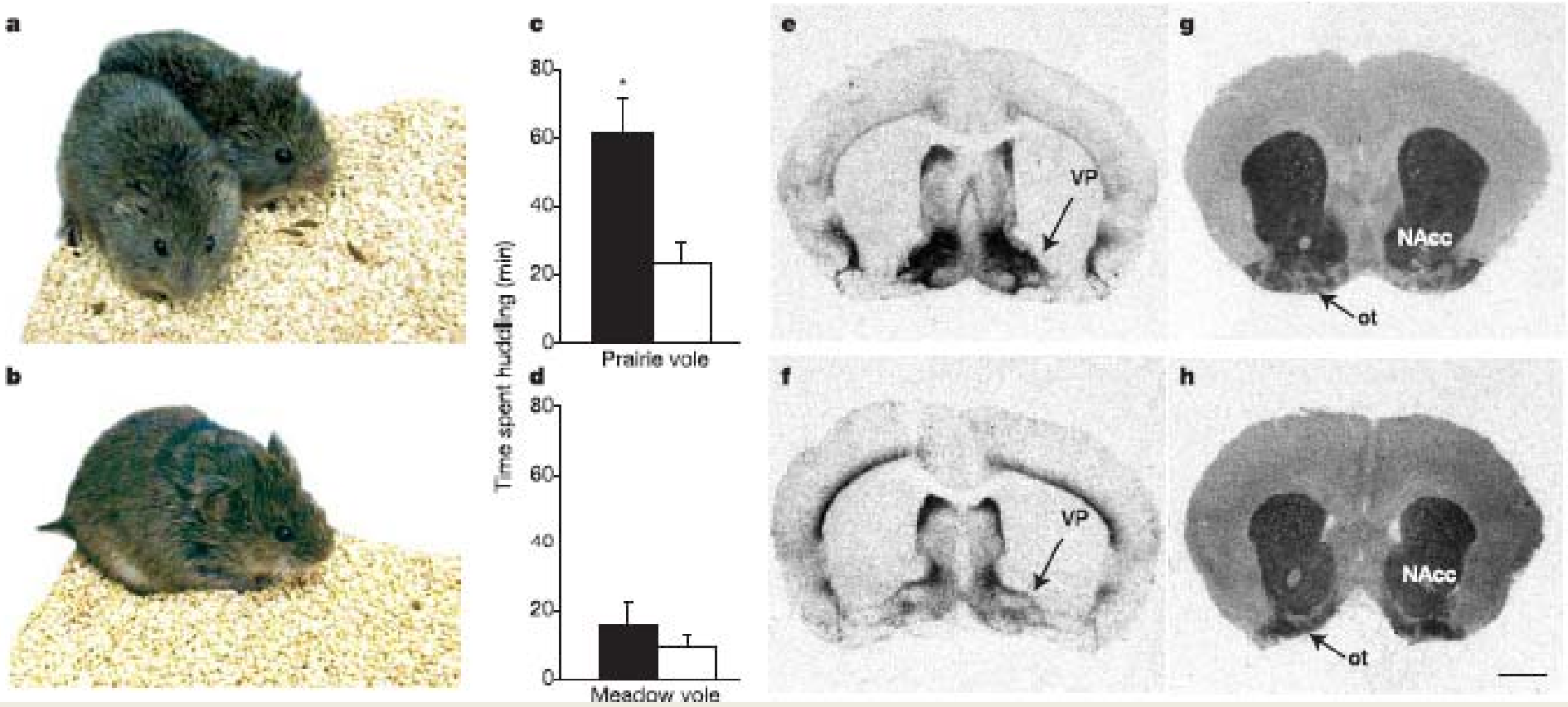
--social behavior/
pair-bonding



Vasopressin receptor (V1aR) located
in the brains.

Vasopressin and pair-bonding

Prairie voles (monogamous) have higher **V1aR** gene expression than meadow voles (polygamous) in the ventral forebrain(both voles have the same gene)



Manipulative experiment

Injecting V1aR protein in the forebrain, polygynous meadow voles spent more time huddling with the partner; whereas control voles did not.

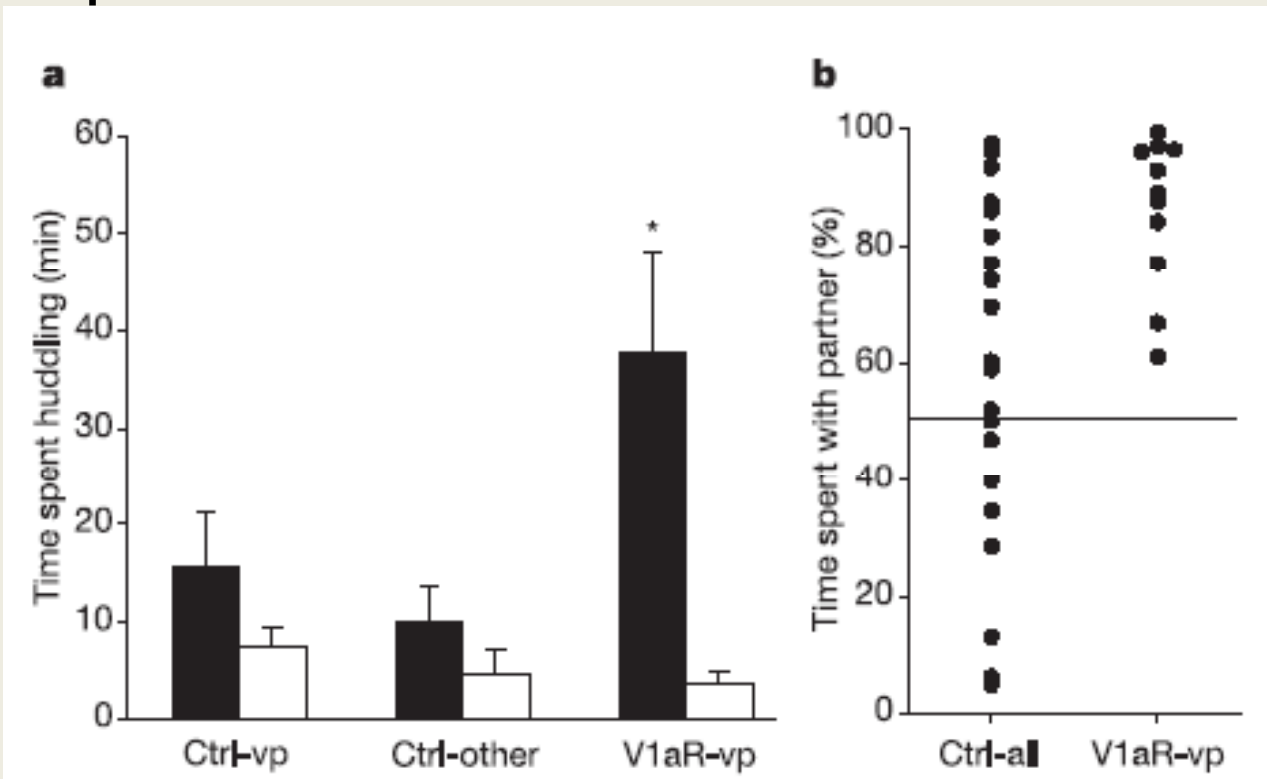


Figure 3 Partner preference test. **a**, V1aR-vp meadow voles spent significantly more time huddling with the partner (filled column) than the stranger (open column), whereas control

Quiz:

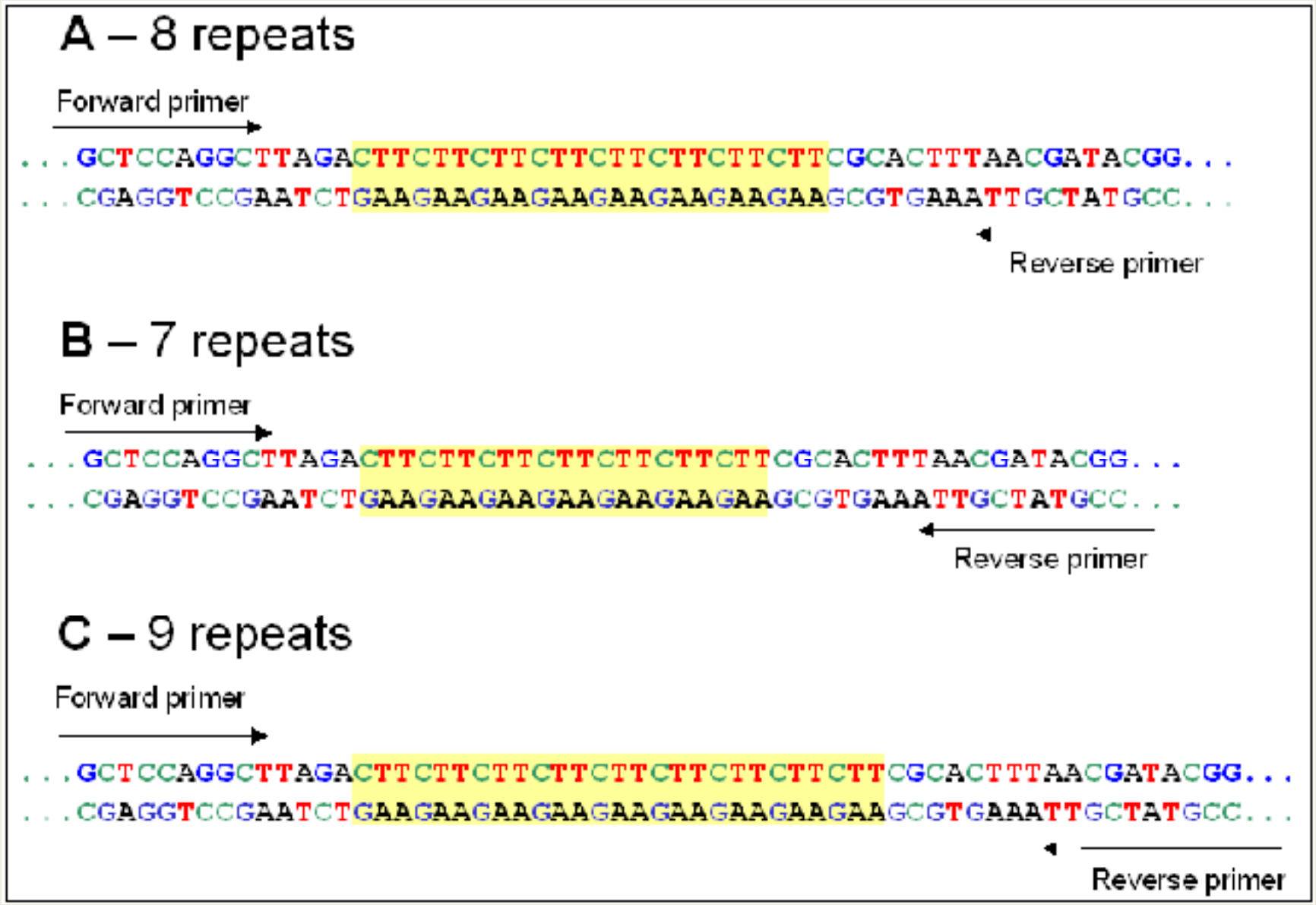
1. Prairie voles have _____than meadow voles (polygynous) in the forebrain.
   (1) More V1aR receptors
   Or ….
   (2) More vasopressin hormones

2. Design experiments to test V1aR expression is critical for pair-bonding?

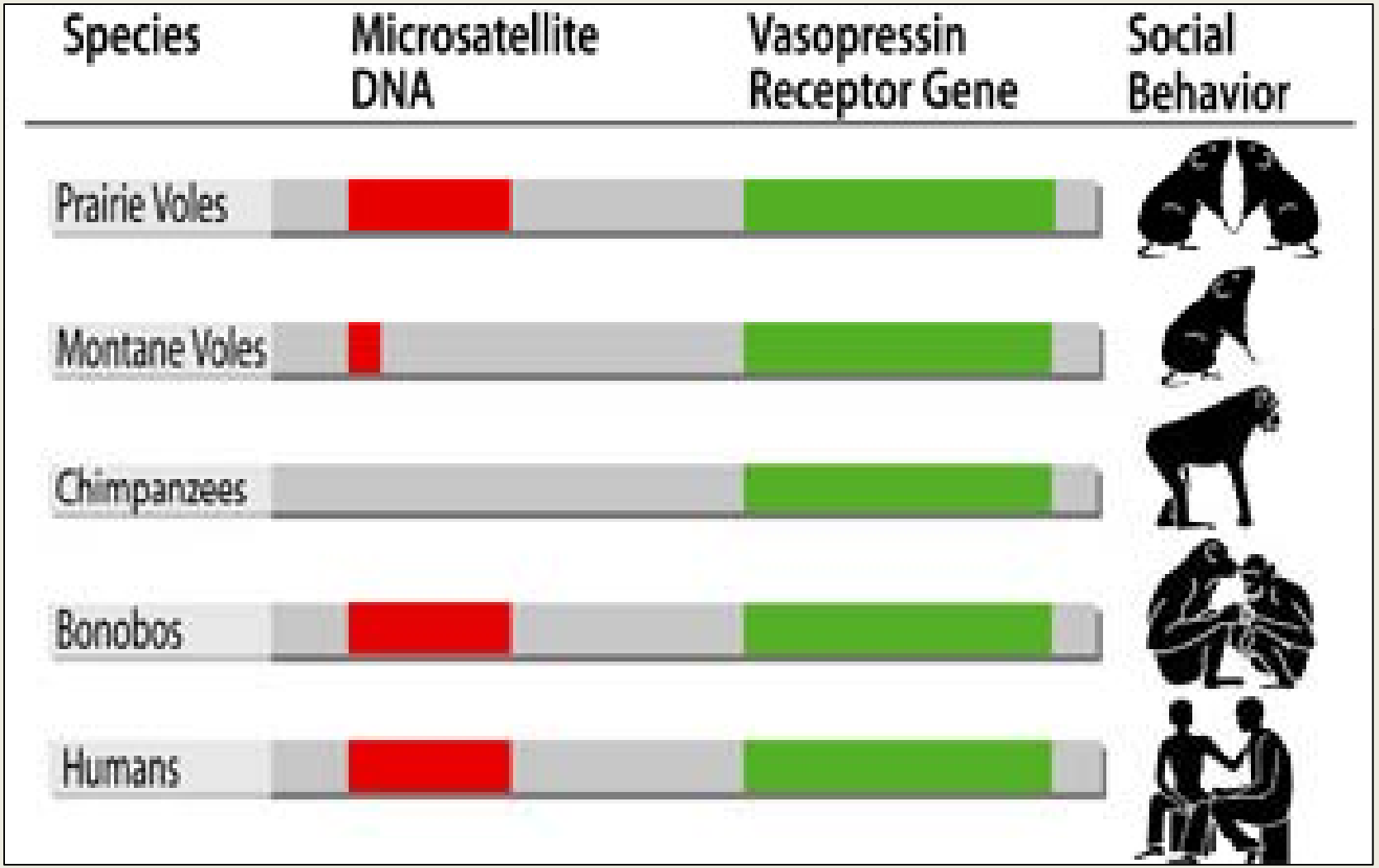
   a. Inhibit V1aR expression: infuse V1aR antagonist
      → inhibit pair bond formation
   b. increase V1aR expression in v. forebrain
      → increase pair-bonding

Monogamous and polygamous voles differ in DNA microsatellite repeats of the V1a-receptor gene (non-coding region)

DNA microsatellite repeats



DNA Microsatellite and Social bonding



Significance

Change in the **expression** of a single gene profoundly alters social behavior.

Evolution of complex social behavior.
- have genetic and environmental influence

Sexual selection, Mating systems, Parental care, and Sexual dimorphism

Uneven distribution of mating success

Male-male (intra-sexual) competition more intense

Sexual dimorphism, less paternal care

Monogamous birds:

More biparental care

Less sexual dimorphism

(males and females look alike)

Polygamous birds:

Less (no) biparental care

More sexual dimorphism

(males and females look differently; behave differently)

Evolution of sexual dimorphism

Harbor seals – Monogamous
More biparental care
Less sexual dimorphism

Elephant seals– Polygynous
More sexual dimorphism
No paternal care

Quiz: Monogamy or Polygamy?

Large song repertoire in males, no song in females

Great reed warbler

Quiz: Polygamy or Monogamy?